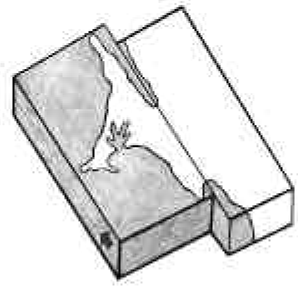
Creating Coastal Stewardship through Science



Uncovering the San Andreas Fault

Post-Visit Activities

What Else Can We Learn About Information in Our Field Journals?

By conducting at least one extension idea, teachers can help students reinforce lessons learned on field trip. Students can also build on these concepts for a "big picture" understanding of plate tectonic, and geologic processes.

Time required: 2 hours
Location: classroom or homework
Suggested group size: independent or student teams
Subjects: earth science, math, physics,
Concepts covered: fault types, rock composition, scientific method
Written by: Christie Denzel Anastasia, National Park Service
Last updated: 04/09/00

Student Outcomes

At the end of this activity, the students will be able to:

- Understand topics covered on field trip in more depth
- Extend lessons learned on field trip to personal interests

California Science Standard Links (grades 6-8)

This activity is linked to the California Science Standards in the following areas:

6th grade 7d - communicate the steps and results from an investigation
7e - recognize whether evidence is consistent with a proposed explanation

7th grade 7c - communicate logical connections among hypotheses, science concepts, tests conducted, data collected, and conclusions drawn from the scientific evidence

National Science Standard Links (grades 5-8)

This activity is linked to the National Science Standards in the following areas:

- Content Standard A - Use appropriate tools and techniques to gather, analyze, and interpret data; Think critically and logically to make the relationships between evidence and explanations;

Recognize and analyze alternative explanations and predictions; Use mathematics in all aspects of scientific inquiry.

- Content Standard B - Motions and forces
- Content Standard D - Earth's history
- Content Standard F - Natural hazards; Risks and benefits.

Procedures

1. Review the list of **Extension Ideas** below. Choose at least one of the activities as a learning continuation of student's Field Journals.

Extension Ideas

PERSPECTIVE

Use the post-visit lesson **What Is the Nature and History of the San Andreas Fault Zone?** (page 109) to put the Earthquake Trail into a regional, national, and international perspective. Students should understand how the displaced fence at Point Reyes National Seashore fits into the movement of the San Andreas Fault and worldwide plate tectonics.

SCIENCE IS NOT SET IN STONE

According to the signs on the Earthquake Trail, the epicenter of the 1906 San Francisco earthquake was Olema Valley, very near to the Trail. Is that true? How and why did the scientific community change their information?

Why do the signs on the Earthquake Trail refer to "continental drift"? What is the difference between continental drift and plate tectonics? Why has the theory changed? What new evidence was presented to convince the scientific community this was necessary?

WHAT CAN YOU TELL ABOUT A ROCK'S HISTORY BASED ON ITS PHYSICAL FEATURES?

Students observed a variety of rocks on their field trip (serpentine, greenstone, marble, schist, etc.). How do their origins contribute to the observations made? For example: does the temperature that the rock cooled at affect its grain size or mineral distribution?

Coordinate information from all of the students to create a chart listing rock types, observable characteristics, and how they were created. Instruct students to bring a rock to class the next day. Using the chart created by their research, what conclusions may they come to about the formation and history of their rock?

SHOE-LENGTH MATH

The Pacific Plate is moving north in relation to the North American Plate. Using your answer to #5 in your journal, calculate how many years it takes for the plates to slide the length of your shoe. (Math hint: divide 220 years by the number of shoe - lengths between the two fences)

220 / __________=__________years.
(shoe lengths)

How far, in shoe lengths, will the plates have moved one million years from now? (Math hint: divide 1,000,000 by your answer to Question three, the number of years it takes the plates to move one shoe length).

1,000,000 /_________=__________shoe lengths in 1,000,000 years
years/ shoe length

In 1,000,000 years the plates will move _________ shoe lengths.

It takes approximately 6000 shoe lengths to equal one mile. Where will Point Reyes National Seashore be located in one million years? In what direction will it be moving?

Over the past 30 million years, major earthquakes have occurred approximately once every 220 years. The last major earthquake on the San Andreas Fault was in 1906. This suggests that we will experience another major earthquake in the Bay Area by what date? (The Loma Prieta Earthquake of 1989 did not release any of the tension building up on this section of the San Andreas Fault.)

If this is true, a major earthquake should occur along the San Andreas Fault by: __________.

Answers:

It will take 8-14 years for the plates to slide the length of your shoe.
The plates move 68,000-113,000 shoe lengths.
In one million years Point Reyes will be 11.3 to 18.9 miles to the north.
Next major earthquake 2126

GEOLOGIC RESOURCES

Assign students various areas in the National Park System to understand in terms of the role of the San Andreas Fault in California or the role of geology in cultures. All of the following information can be found at **www2.nature.nps.gov/grd** ("Visit the National Parks Geology Tour")

<u>Role of the San Andreas Fault in Californa</u>

Channel Islands National Park, California
Cabrillo National Monument, California
Golden Gate National Recreation Area, California

Joshua Tree National Park, California
Muir Woods National Monument, California
Pinnacles National Monument, California
Point Reyes National Seashore, California
Santa Monica Mountains National Recreation Area, California

Role of Geology in Cultures

Alibates Flint Quarries National Monument, Texas
Bering Land Bridge National Park, Alaska
Gila Cliff Dwellings National Monument, New Mexico
Keweenaw National Historic Park, Michigan
Klondike Gold Rush National Historic Park, Alaska and Washington
Mesa Verde National Park, Colorado
Mount Rushmore National Monument, New Mexico
Pipestone National Monument, Minnesota
Russell Cave National Monument, Alabama
Wright Brothers National Memorial, North Carolina
Yukon-Charley River National Preserve, Alaska

DIFFERENT FAULT TYPES CAUSE DIFFERENT LAND FEATURES

Have student refer to question #5 in their journals. Divide students into research teams. Each team is assigned a type of fault. Their challenge is to: illustrate their fault with a skit while the rest of the class attempts to guess which specific fault they are imitating.

Examples of faults in the world:

normal faults:

Tetons, Sierra Nevadas, Basin and Range,
Rhine Valley, East Africa

reverse/thrust faults

Northern Rockies, Alps, Himalayas, and Appalachians

SO WHAT?

Assign students to write an essay outlining the relevance of geology to their lives. There are no right or wrong answers; the only requirement is that students think critically and can logically support their reasoning process.

CRITICAL CONCEPTS

The following information is from the American Association for the Advancement of Science's publication, "Benchmarks for Scientific Literacy," 1993, section 10E, Moving the Continents (9-12 grade).

- The story of why science accepted the idea of moving continents only after the long resistance illuminates the conservatism of the scientific enterprise. Contrary to the popular public image of scientists as radicals ready to discard their beliefs instantly in the face of contrary "facts," the plate tectonics episode shows that it sometimes takes a large accumulation of evidence over an extended period of time to provoke a dramatic shift in what most scientists in a discipline accept as true.

- The history of the rise of the theory of plate tectonics shows that the acceptance of a theory depends on its explanatory power as well as on the evidence that supports it. As it has turned out, the modern theory of plate tectonics makes sense out of such a large and diverse array of phenomena related to the earth's surface that it now serves as a unifying principle in geology. In a sense, plate tectonics does for geology what evolution does for biology.

- The idea of continental drift was suggested by the matching shapes of the Atlantic coasts of Africa and South America, but rejected for lack of other evidence. It just seemed absurd that anything as massive as a continent could move around.

- Early in the 20th century, Alfred Wegener, a German scientist, reintroduced the idea of moving continents, adding such evidence as the underwater shapes of the continents, the similarity of plants and animals in corresponding parts of Africa and South America, and the increasing separation of Greenland and Europe. Still, very few contemporary scientists adopted his theory.

- The theory of plate tectonics was finally accepted by the scientific community in the 1960's, when future evidence had accumulated in support of it. The theory was seen to provide an explanation for a diverse array of seemingly unrelated phenomena, and there was a scientifically sound physical explanation of how such movement could occur.

What Is the Nature and History of the San Andreas Fault Zone?

Students investigate the San Andreas Fault in terms of earthquakes, visible evidence, and its relationship to the world and California. This lesson will also assist students to synthesize pre-visit and on-site activities and experiences.

Time required: 30 minutes in class and homework assignment
Location: classroom
Group size: independent
Subject: science
Concepts covered: plate tectonics, earthquakes, topography
Written by: Christie Denzel Anastasia and Lynne Dominy, National Park Service
Last updated: 04/03/00

Student Outcomes

At the end of this activity, the students will be able to:

- Complete their understanding of the San Andreas Fault Zone
- Draw the San Andreas Fault on maps of the world and California
- Be aware of the San Andreas Fault Zone's contribution to California topography
- Synthesize information from other activities in this guide

California Science Standards Links (grades 6-8)

This activity is linked to the California Science Standards in the following areas:

6th grade
1a - the fit of the continents, location of earthquakes, etc., provide evidence for plate tectonics
1c - lithospheric plates that are the size of continents and oceans move at rates of centimeters per year in response to movements in the mantle
1d - earthquakes are sudden motions along breaks in the crust called faults
1e - major geologic events, such as earthquakes, volcanic eruptions, and mountain building result from plate tectonics
1f - explain major features of California geology in terms of plate tectonics (including mountains, faults, volcanoes)

1g - how to determine the epicenter of an earthquake and that the effects of an earthquake vary with its size, distance from the epicenter, local geology, and the type of construction involved
4c - heat from the earth's interior reaches the surface primarily through convection
7b - select and use appropriate tools and technology to perform tests, collect and display data
7e - recognize whether evidence is consistent with a proposed explanation

7th grade
7a - select and use appropriate tools and technology to perform tests, collect and display data
7b - utilize a variety of print and electronic resources, including the World Wide Web, to collect information
7d - construct scale models, maps, and appropriately labeled diagrams to communicate scientific knowledge (e.g., motion of earth's plates and cell structures)

8th grade
9b - evaluate the accuracy and reproducibility of data

National Science Standard Links (grades 5-8)

This activity is linked to the National Science Standards in the following areas:

- Content Standard A - Use appropriate tools and techniques to gather, analyze, and interpret data; Think critically and logically to make the relationships between evidence and explanations; Understanding about scientific inquiry.
- Content Standard B - Motions and forces; Transfer of energy.
- Content Standard D - Earth's history.
- Content Standard F - Natural hazards; Risks and benefits.

Materials

To be photocopied from this guide:

- **Where is the San Andreas Fault Zone Found in Relation to World-Wide Tectonic Plates?** Activity Sheet
- **Where is the San Andreas Fault Zone Found in Relation to Earthquakes in California?** Activity Sheet
- **What Visible Evidence Exists of the San Andreas Fault Zone?** Activity Sheet

To be supplied by teacher:

- California atlas or access to Internet programs such as "Mapquest" for **Where Is the San Andreas Fault Zone Found in Relation to Earthquakes in California?** Activity Sheet

Vocabulary

sag pond, shutterridge, subduction, tsunami

Procedures

1. **Free information**
   Consider ordering some of the free information listed in the "Resources" section of this guide. This information will help students with the activity sheets.

2. **Brainstorm "known and unknown" of the San Andreas Fault**
   Using the blackboard or a large piece of paper, divide the space into two columns. One section will be space for students to brainstorm what they already know about the San Andreas Fault Zone while the other section will be what they do not know.

Examples:	Width:	few hundred feet to a mile wide
	Depth:	10 miles deep
	Length:	800 miles
	Age:	15-20 million years
	Length through Point Reyes Peninsula: 30 miles	
	How does it move?	
	When was the last time it moved?	
	What is the average displacement?	

3. **Investigate "unkowns"**
   Students or groups of students can be challenged to discover the answers to some of their "unknowns."

4. **Assignment (in class or homework)**
   Distribute relevant activity sheets to students or teams.

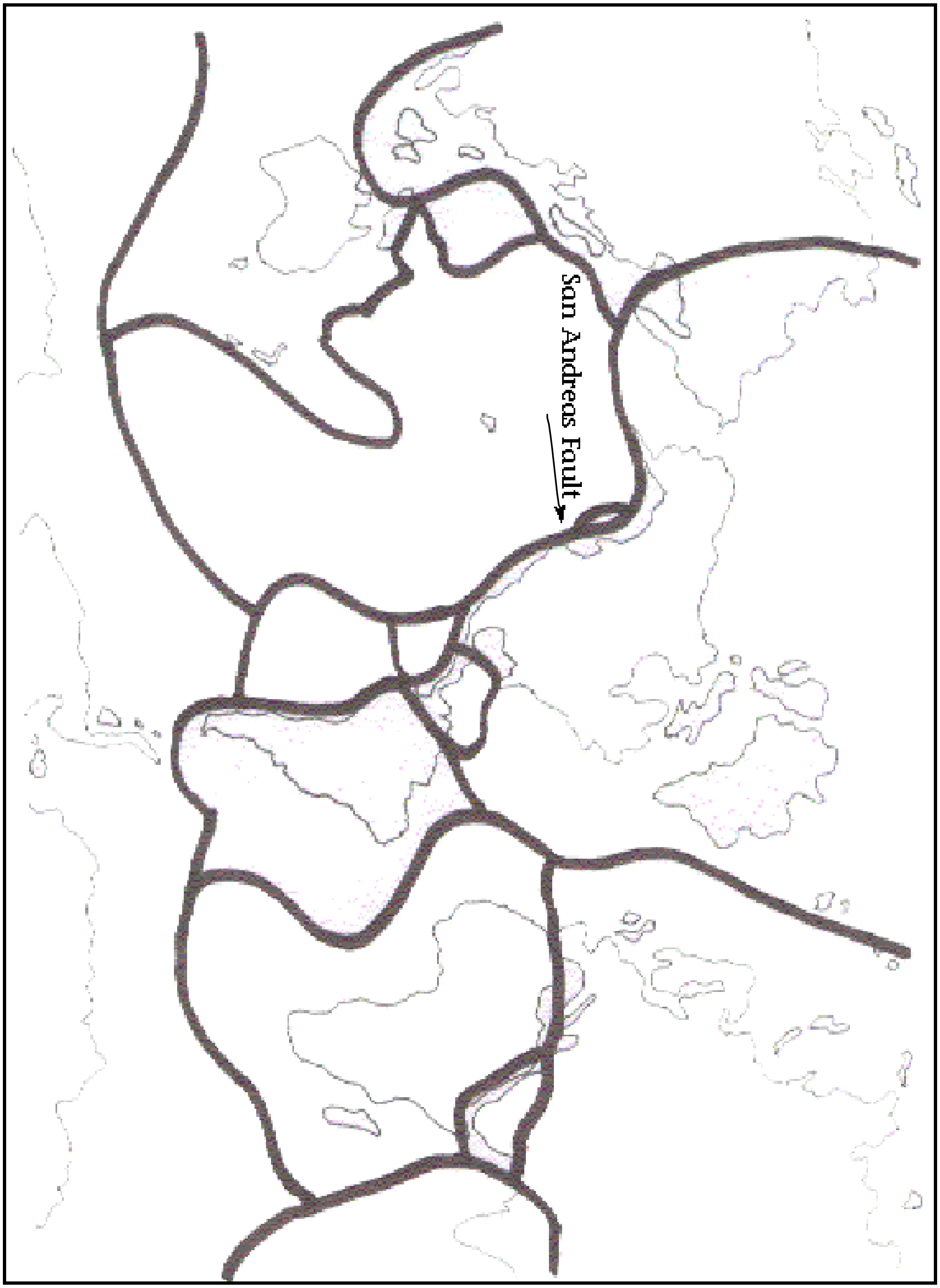
5. **Review**
   Use the review of the activity sheets and the experience of seeing the displaced fence on the Earthquake Trail to communicate the importance of visible earthquake evidence and the role of plate tectonics.

Extension Idea

1. Gather aerial views of the San Andreas Fault Zone from various sources. Students can use these views to illustrate "Visible Evidence" from activity sheets.

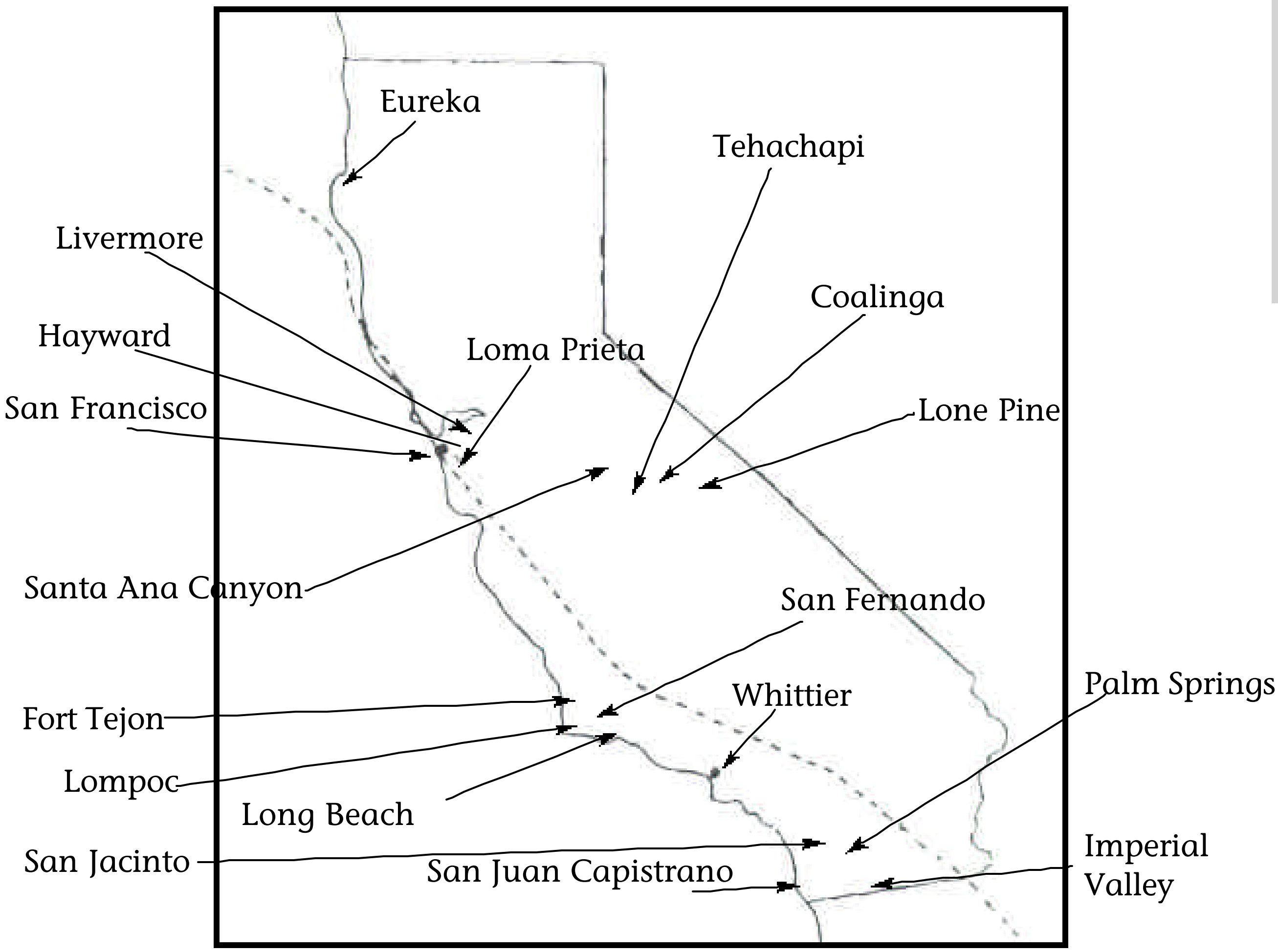
Where Is the San Andreas Fault Zone Found in Relation to World-Wide Tectonic Plates?

Locate a map of the world that illustrates major tectonic plates. Specifically draw (on the map below) where at least eight major plates are located. Finally, mark where the San Andreas Fault is found.



Where Is the San Andreas Fault Zone Found in Relation to Earthquakes in California?

Find a map showing where the San Andreas Fault Zone lies in California. Draw and label this zone on the map below. Then, using a detailed map of California and the list of major California earthquakes below, indicate which of these earthquakes the San Andreas Fault caused. (Hint: locate the town and determine if it's close enough to have been affected by the fault).



California Earthquakes							
date	location	magnitude	intensity	date	location	magnitude	intensity
1769	Santa Ana Canyon	8.0	XI	1933	Long Beach	6.3	IX
1812	San Juan Capistrano	7.0	X	1940	Imperial Valley	7.1	X
1836	Hayward	7.0	X	1952	Tehachapi	7.7	XI
1838	San Francisco	7.0	X	1971	San Fernando	6.6	XI
1857	Fort Tejon	7.7	X	1979	Imperial Valley	6.4	IX
1861	Livermore	7.0	VII	1980	Eureka	7.0	VII
1872	Lone Pine	8.3	XI	1983	Coalinga	6.7	VIII
1906	San Francisco	8.3	X	1986	Palm Springs	6.0	VII
1918	San Jacinto	6.8	IX	1987	Whittier	5.9	VIII
1925	Lompoc	7.5	X	1987	Imperial Valley	6.3	IX
1929	Whittier	6.8	XI	1989	Loma Prieta	7.1	X

What Visible Evidence Exists of the San Andreas Fault Zone?

Circle the visible evidence directly related to movements of the San Andreas Fault Zone. If you are unsure, note the reason why you think it may be evidence. Use the geology vocabulary list provided by your teacher and other sources to assist with this activity sheet.

Mountain-building zones

Oceanic trenches

Cambrian rock forms

Streams with sudden bends

Tomales Bay

River valleys drained

Offset stream course

Cave creation

Dunes

Shutterridge

Tsunamis

Sag pond

Weathered rocks

Side-hill bench

Bolinas Lagoon

Creeks close together flowing in opposite directions

Wind-caused erosion

New river valleys formed

Fossils

Valleys without streams

Volcanoes

Subduction zones

Underground rivers

Coastal erosion

Sandy shores

Rock joints

Drowned coastlines

Asteroids

Altered slope of hills

Creation of coral reefs

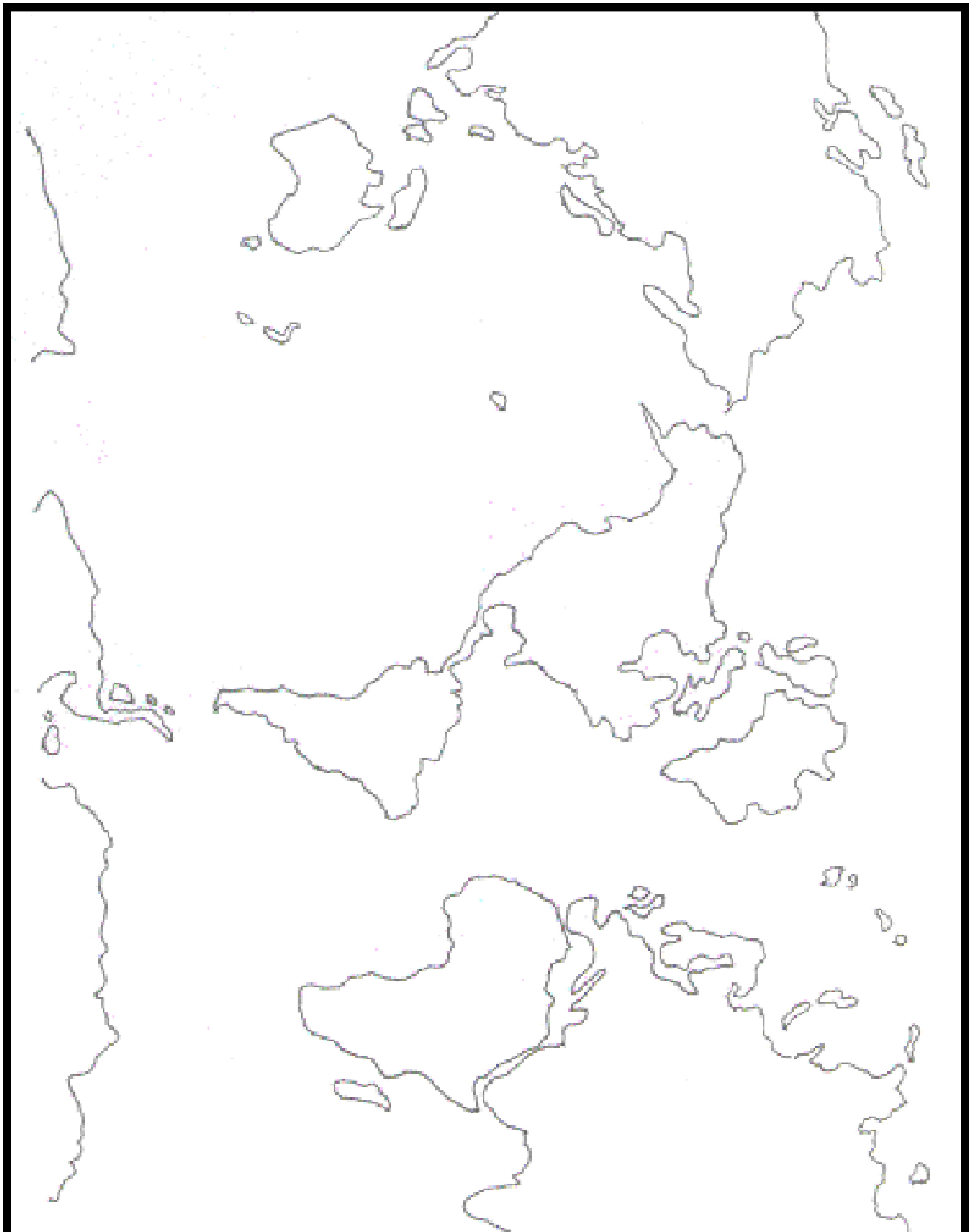
Linear trough or valley

Creation of glaciers

Name ______________________________ Date ______________

Where Is the San Andreas Fault Zone Found in Relation to World-Wide Tectonic Plates?

Locate a map of the world that illustrates major tectonic plates. Specifically draw (on the map below) where at least eight major plates are located. Finally, mark where the San Andreas Fault is found.



Name ______________________________ Date ______________

Activity Sheet

Where Is the San Andreas Fault Zone Found in Relation to Earthquakes in California?

Find a map showing where the San Andreas Fault Zone lies in California. Draw and label this zone on the map below. Then, using a detailed map of California and the list of major California earthquakes below, indicate which of these earthquakes the San Andreas Fault caused. (Hint: locate the town and determine if it's close enough to have been affected by the fault).

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1836	Hayward	7.0	X	1952	Tehachapi	7.7	XI
1838	San Francisco	7.0	X	1971	San Fernando	6.6	XI
1857	Fort Tejon	7.7	X	1979	Imperial Valley	6.4	IX
1861	Livermore	7.0	VII	1980	Eureka	7.0	VII
1872	Lone Pine	8.3	XI	1983	Coalinga	6.7	VIII
1906	San Francisco	8.3	X	1986	Palm Springs	6.0	VII
1918	San Jacinto	6.8	IX	1987	Whittier	5.9	VIII
1925	Lompoc	7.5	X	1987	Imperial Valley	6.3	IX
1929	Whittier	6.8	XI	1989	Loma Prieta	7.1	X

Name ______________________________ Date ______________

Activity Sheet

What Visible Evidence Exists of the San Andreas Fault Zone?

Circle the visible evidence directly related to movements of the San Andreas Fault Zone. If you are unsure, note the reason why you think it may be evidence. Use the geology vocabulary list provided by your teacher and other sources to assist with this activity sheet.

Mountain-building zones	New river valleys formed
Oceanic trenches	Fossils
Cambrian rock forms	Valleys without streams
Streams with sudden bends	Volcanoes
Tomales Bay	Subduction zones
River valleys drained	Underground rivers
Offset stream course	Coastal erosion
Cave creation	Sandy shores
Dunes	Rock joints
Shutterridge	Drowned coastlines
Tsunamis	Asteroids
Sag pond	Altered slope of hills
Weathered rocks	Creation of coral reefs
Side-hill bench	Linear trough or valley
Bolinas Lagoon	Creation of glaciers

Creeks close together flowing in opposite directions

Wind-caused erosion

What Is It Like to Be in an Earthquake?

Students will share human experiences of earthquakes. This may be done through their own experiences, oral history interviews, or magazine articles. Implications and safety procedures of living near the San Andreas Fault will be discussed.

Time required: 1 hour homework interview or research
Location: varies
Suggested group size: independent work
Subjects: earth science, social science
Concept covered: earthquakes
Written by: Mike Schulist
Last updated: 04/02/00

Student Outcomes

At the end of this activity, students will be able to:

- Understand the experience of a major earthquake
- Appreciate the implications of living near a major fault line
- Relate earthquake studies at Point Reyes National Seashore to events closely affecting their lives

National Science Standard Links (grades 5 - 8)

This activity is linked to the National Science Standards in the following areas:

- Content Standard F - Natural hazards; Risks and benefits.

Materials

To be photocopied from this guide:

- **What Is It Like to Be in an Earthquake?** Activity Sheet

Procedures

1. **Assist students to choose one of the methods below (Oral Interviews or Research) for understanding the experience of an earthquake**

   Oral Interviews:

   - Do you know someone who was in the Loma Prieta Earthquake of 1989?

• Do you know someone who was in another major earthquake?
• Have you ever been in a major earthquake?
If students answer yes to any of these questions, they will conduct an oral interview using the attached activity sheets.

Research:
• If you do not know anyone personally, you may need to locate information which depicts the human side of earthquakes. Many magazines (such as Time or Newsweek) published after the Loma Prieta Earthquake have articles. Students may also use the Internet to locate stories. These students may also use the **What Is It Like to Be in an Earthquake?** Activity Sheets, but will modify the answers according to the information provided.

2. **Students summarize research in reports**
Instruct students to use their completed activity sheets to write a one-page report according to the following outline:
What was remembered most about the earthquake?
Did the person change behaviors as a result of the experience?
What advice would you give this person for the next potential earthquake?

3. **Have students hand in activity sheets and reports**
Display reports on a bulletin board in the hallway or cafeteria where other students may contemplate implications and precautions for living next to the San Andreas Fault.

Extension Ideas

1. Students research articles about California earthquakes and report on their findings.
2. Find pictures of the devastation caused by earthquakes in the Bay Area and have students make a photo collage.
3. Students create poster boards or pamphlets teaching about earthquake safety procedure.
4. Students film and edit an interview of someone with a particularly moving story of earthquake survival to share with other students.
5. Students organize and practice an earthquake safety drill for their school.

Activity Sheet

Name ________________________________ **Date** ______________

What Is It Like to Be in an Earthquake?

Living in California, most of us have experienced the rumblings of an earthquake. Some of us have had our lives changed by earthquakes - the loss of a friend or loved one, of personal property, or perhaps just the memory of feeling the earth sway beneath us.

Your job is to find someone whose life has been touched powerfully by an earthquake. Start with your parents, and if they can't help you, ask them to lead you to someone who can. Friend's parents, relatives, older brothers or sisters all probably have good memories of what they were doing on October 17, 1989, when the Loma Prieta Earthquake struck.

Find someone with an interesting story and conduct an interview. You might bring a tape recorder so you can keep the flow of conversation going and copy your answers down later. Listen politely to the experiences of others - chances are you will someday have a story to tell about earthquakes, if you don't have one already...

1. What is the name of the person you will interview?

2. Why did you choose to interview this person?

<u>TYPES OF QUESTIONS TO ASK:</u>

3. What earthquake were you in?

4. Where were you when the earthquake hit?

Activity Sheet

Name ______________________________ **Date** _____________

5. What did it feel like to experience an earthquake?

6. What damage was done to the area around you as a result of the earthquake?

7. What did you do while the ground was shaking to make yourself safe?

8. How much earthquake safety preparation did you have before the earthquake?

9. If you had earthquake safety preparation, how did it help you during the earthquake?

10. What do you remember most about this earthquake?

What Earthquake Information Is Available on the World Wide Web, and Why Is It Important?

Students will research an earthquake of their choice based on a list of most recent earthquakes in the world. A worksheet will guide this process and prompt students to realize the importance of seismic research.

Time required: 1 hour
Location: classroom or homework assignment (requires Internet access)
Suggested group size: individual or student teams
Subjects: science, physics, math, computer literacy
Concepts covered: earth science, hazard prevention, earthquakes
Written by: Christie Denzel Anastasia, National Park Service
Last updated: 04/09/00

Student Outcomes

At the end of this activity, the students will be able to:

- Utilize on-line earthquake information
- Make the connection between seismic research and relevance to their lives

California Science Standard Links (grades 6-8)

This activity is linked to the California Science Standards in the following areas:

6th grade
1a - the fit of the continents, location of earthquakes, etc., provide evidence for plate tectonics
1c - lithospheric plates that are the size of continents and oceans move at rates of centimeters per year in response to movements in the mantle
1d - earthquakes are sudden motions along breaks in the crust called faults
1e - major geologic events, such as earthquakes, volcanic eruptions, and mountain building result from plate tectonics
1f - explain major features of California geology in terms of plate tectonics (including mountains, faults, volcanoes)
1g - how to determine the epicenter of an earthquake and that the effects of an earthquake vary with its conditions

7d - communicate the steps and results from an investigation

7th grade 7b - utilize a variety of print and electronic resources, including the World Wide Web, to collect information

7c - communicate logical connections among hypotheses, science concepts, tests conducted, data collected, and conclusions drawn from the scientific evidence

8th grade 9b - evaluate the accuracy and reproducibility of data

National Science Standard Links (grades 5-8)

This activity is linked to the National Science Standards in the following areas:

- Content Standard A - Use appropriate tools and techniques to gather, analyze, and interpret data; Develop descriptions, explanations, predictions, and models using evidence; Think critically and logically to make the relationships between evidence and explanations.
- Content Standard B - Motions and forces.
- Content Standard D - Earth's history.
- Content Standard F - Personal health; Natural hazards; Risks and benefits.

Materials

To be provided by the teacher:

- Access to Internet (if not available at home/public library)

To be photocopied from this guide:

- **What Earthquake Information Is Available on the World Wide Web, and Why is it Important** Activity Sheet, one per student or team

Vocabulary

generated by student inquiry

Procedures

1. **Review assignment**
   Distribute activity sheets to be completed (using information available on the Internet). Students may work independently or in teams.

2. **Generate class discussion**
   Use Question #4 on the activity sheet to discuss the relevance of current earthquake information to various professions, agencies, and individuals. Do students think tax dollars should be spent on this type of research? Why or why not?

Extension Idea

1. What information is missing from the Internet? Were students looking for information they could not locate? Ask students to plan and create a website.

Name ______________________________ **Date** _____________

What Earthquake Information Is Available on the
World Wide Web, and Why Is It Important?

You will need a computer with Internet Access for about 30 minutes to complete the following exercise.

1. Navigate to United States Geologic Society at **www.usgs.gov.**
   - Select "Earthquake Information" from list of options.
   - Choose one earthquake from "List of Most Recent Earthquakes" for this assignment.
   - You may want to search for the closest, most recent, or an international earthquake.
   - After completing the following information, double click on the title of the earthquake you have chosen to view its location.

Earthquake:	
Day:	Time:
Latitude:	Longitude:
Depth:	Magnitude:
Real time conversion (click on "UTC" for instruction):	

2. Select "Historical Seismicity," located under the earthquake map.

What has been the earthquake activity of this area in the past?

Activity Sheet

Name ______________________________ Date _____________

3. Select "P-Wave Travel Times;" located under earthquake map.

How much time would it take the waves to reach New York City?

4. Go to **www.usgs.gov**; in the Search Option type "Hazard Maps Help Save Lives and Property"; select "Hazard Maps Fact Sheet." Read the article "Hazard Maps Help Save Lives and Property" and answer the following questions.

Why could an earthquake in the central or eastern United States cause as many casualities and as much damage as several earthquakes of similar magnitude in California?

List four reasons that up-to-date earthquake maps can save lives and property.

5. Do you have any questions about earthquakes? You can send your question to **Ask-A-Geologist@usgs.gov**. Share your answers from the geologist with the rest of your class.

What Is Our Earthquake Safety Plan?

Given the real probability of an earthquake occurring in Northern California in the next 30 years, students will create an earthquake safety plan for home and school.

Post-Visit Lesson Plan

Time required: 1 hour
Location: classroom
Suggested group size: entire class
Subject: science
Concepts covered: natural disasters, hazards, and prevention
Adapted from: various United States Geologic Survey sources
Written by: Christie Denzel Anastasia, National Park Service
Last updated: 04/07/02

Student Outcomes
At the end of this activity, the students will be able to:
- Create an Earthquake Safety Plan and Earthquake Kit

National Science Standard Links (grades 5-8)
This activity is linked to the national science standards in the following areas:
- Content Standard F - Natural Hazards, Risks and Benefits

Materials
To be provided by the teacher:
- Books, pamphlets, or other sources of information regarding earthquake safety
- Many on-line materials regarding earthquake could be made available to students as reading material

Vocabulary
generated by student inquiry

Procedures
1. **Introduction to earthquakes in California**
   As of yet, there is no scientifically verifiable way to predict earthquakes. We can only determine when they are likely to occur, what the shaking will be like, and what the result of that shaking will

Creating Coastal Stewardship through Science

be on certain types of engineering. The geologic record of fault movement in California tells us to expect an average of approximately seven earthquakes of magnitude seven or greater every century. With this in mind, we cannot prevent earthquakes, but we can be prepared with the right tools and mental attitudes.

2. **What would you expect to happen?**
   Discuss expectations of earthquakes. Create a list on the blackboard of various situations created by earthquakes. (Example: houses shift, roads crack, electricity is lost.)

3. **What are the hazards?**
   Based on their list of situations, what would be the disasters and possible results of those disasters? If students listed "large cracks are created in the ground", a result of that may be a dangerous hole is created and buildings slide into the cracks. Other situations may include falling buildings, power lines tilt or break, tsunamis, dam breaks, or landslides. Once these hazards and results are identified, group them according to major, moderate, or minor hazards.

4. **What would you do if you were in a_________?**
   Discuss how students' reactions and responses to an earthquake may vary based on their location at the time. List the following situations and have students discuss what they would do if they found themselves in these situations during an earthquake.

indoors	beach
outside	shopping mall
driving	sidewalk near building
mountainous area	stadium
wheelchair (or with someone in a wheelchair)	
library	

5. **What would you do after an earthquake?**
   What are the proper behaviors and actions after an earthquake? Have students brainstorm and prioritize their answers to this question.

   - use flashlights or battery-powered lanterns (lighters or candles should not be used until you are sure there are no gas leaks)
   - use telephones only for life-threatening emergencies
   - listen to battery-powered radios
   - watch out for existing hazards and aftershocks
   - help those who are injured

6. **Planning**
   Based on students' list of behaviors and actions after an earthquake, what are some planning actions that could make this time a little easier?

   Create an Earthquake Kit
   What should be in this kit? Do we have one? Where is it? (radio, flashlight, extra batteries, nonperishable food, first aid kit, wrench to turn off gas/water, alternate cooking source, essential medication)

   Create an Earthquake Safety Plan
   Investigate existing hazards at home/in the neighborhood/at school. Where should you be during the earthquake? Where will you meet others after the shaking? Where is the Earthquake Kit located?

7. **Practice an earthquake drill**
   Create a scenario of an earthquake. The ground starts shaking during class. What should students do first? How long should they stay like that? What should they expect when they go home? Based on this practice session, would they have done anything differently?

Extension Ideas

1. What are existing building codes for school buildings? Is your school up to code? Who is responsible for ensuring earthquake safety? As of 1985, building codes have been based on different types of soil (hard rock, firm (sandy) soil, and soft (clay soil). What is the predominant soil type under your school? What does that mean in terms of earthquakes?

2. Investigate the current seismic retrofit of the San Francisco Bay Bridge. What are they doing, and how will that help during an earthquake? What would be possible results if they did not retrofit the bridge?